

EXHIBIT S

Honeywell



Honeywell High Performance Products

High

Isolation

Switches



Honeywell As Your RFIC Partner

Honeywell's family of RF switches offers an effective solution for your RFIC needs. We fuse our proven reliability with innovative technology solutions to offer the value, quality and service you need in a RFIC provider.

By partnering with Honeywell, you're teaming up with a pioneer of Silicon On Insulator (SOI) CMOS technology with over 24 years of experience in SOI IC designing, development and manufacturing. We use latest six sigma based process controls to ensure your products maintain the quality and stability you expect from Honeywell.

With SOI CMOS technology, our products integrate CMOS control logic and ESD protection, operate from a single positive supply voltage, and have exceptionally high channel-to-channel isolation. In addition, CMOS SOI technology provides the performance of GaAs with the economy of conventional bulk CMOS.

Products You Can Rely On

The Honeywell family of RF switches is ideal for use in a wide range of wireless applications that require accuracy, compact packaging and low power consumption. Our switches operate optimally in cellular, Personal Communications Service (PCS) and Global System for Communications (GSM) basestations and 2.4 GHz Wireless Local Area Network applications.

In addition to providing quality products, we offer support to ensure our devices work effectively as designed in your components. You receive the added benefit of our expertise in designing and developing ICs when you choose Honeywell as your supplier.

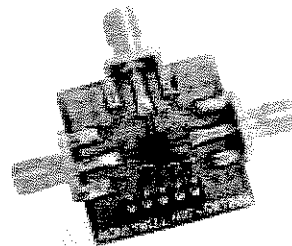
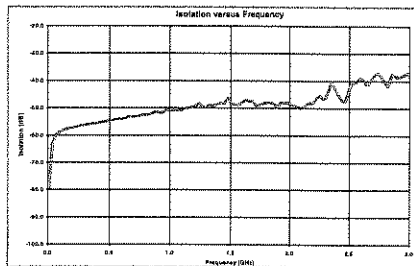
Visit our www.mysoiservices.com to receive more information about our products and to locate a sales representative near you. Order evaluation boards through our worldwide distributor, Richardson Electronics, at <http://www.rfpower.net>.

SPDT Absorptive RF Switch ? HRF-SW1000

The Honeywell HRF-SW1000 is a high performance Single Pole Double Throw (SPDT) absorptive RF switch. The SW1000 switch, available in a space-saving 3"x 3" 12-pin LPCC™ package, is ideal for use in wireless basestation applications that require a combination of high isolation and ultra low DC power. It is designed using Honeywell's patented Silicon On Insulator (SOI) CMOS technology to offer high integration and reduced cross talk.

Features

- High isolation > 40 dB @ 2 GHz
- Low insertion loss of 1.1dB @ 2 GHz
- DC To 4GHz operating frequency
- Impedance matched for 50 Ohm systems
- Integrated CMOS control logic
- Integrated ESD protection on digital I/O
- Single positive supply voltage



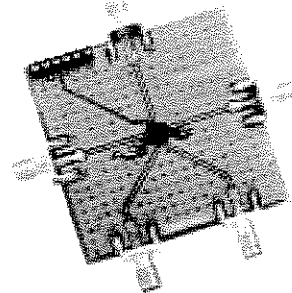
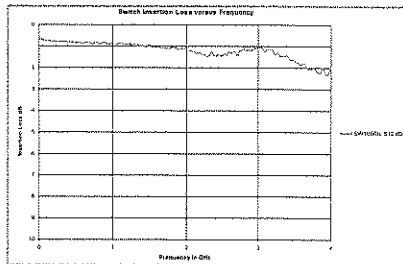
The **HRFSW1001** is a SPDT Absorptive RF Switch compatible with 75 Ohm systems, and also offers first in class isolation levels and low insertion loss.

SP4T Absorptive RF Switch - HRF-SW1020

The Honeywell HRF-SW1020 is a high performance Single Pole Four Throw (SP4T) absorptive RF switch. The SW1020 switch, available in a space-saving 4"x4" 20 pin LPCC™ package, boasts an isolation level of >50 dB @ 1 GHz. It is designed using Honeywell's patented Silicon On Insulator (SOI) CMOS technology to offer high integration and reduced cross talk.

Features

- High isolation > 40 dB @ 2 GHz
- Low insertion loss of 1.2dB @ 2 GHz
- DC to 3 GHz operating frequency
- Impedance matched for 50 Ohm systems
- Integrated CMOS control logic
- Integrated ESD protection on digital I/O
- Single positive supply voltage



The **HRFSW1021** is a **SP4T** Absorptive RF Switch compatible with 75 Ohm systems, and also offers first in class isolation levels and low insertion loss.

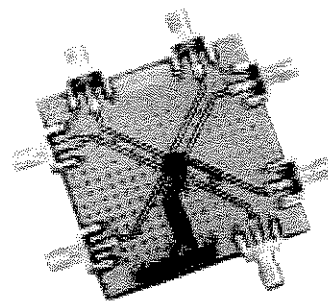
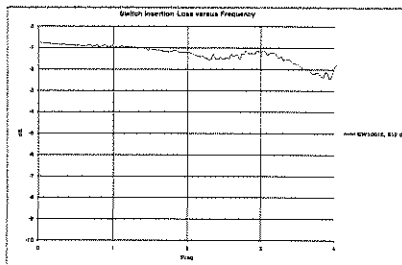
Our new **HRF-SW1022 RF** switch, matched for 50 Ohm systems, operates to 6 GHz with excellent isolation and low insertion loss at high frequency.

SP6T Absorptive RF Switch - HRF-SW1030

The Honeywell HRF-SW1030 is a high performance Single Pole Six Throw (SP6T) absorptive RF switch. The SW1030 switch, available in a space-saving 4"x4" 24-pin LPCC™ package, features an all off state and is ideal for applications requiring integrated decoders and ultra low DC power. It is designed using Honeywell's patented Silicon On Insulator (SOI) CMOS technology to offer high integration and reduced cross talk.

Features

- High isolation > 40 dB @ 2 GHz
- Low insertion loss of 1.9 dB @ 2 GHz
- DC to 3 GHz operating frequency
- Impedance matched for 50 Ohm systems
- Integrated CMOS control logic
- Integrated ESD protection on digital I/O
- Single positive supply voltage



For switches compatible with 75 Ohm systems, try our HRF-SW1031 that also offers first in class isolation levels and low insertion loss.

4X6 RF Matrix Switch - HRF-SW1040 (In Development)

The Honeywell HRF-SW1040 is a high performance four (4) input by six (6) output RF distribution switch, that is ideal for use in wireless base station applications that require minimum power and optimum integration. Under independent parallel control, each of 4 inputs are connected exclusively to any of 6 RF outputs. With dual band operation, four channels are capable of supporting two bands: 1 AMPS and 3 PCS; and 3 AMPS and 1 PCS antenna connections. It is designed using Honeywell's patented Silicon On Insulator (SOI) CMOS technology to offer high integration and reduced cross talk.

Features

- Dual band (AMPS/PCS) operation
- High isolation ~ 25 dB
- Low insertion loss of ~12dB
- Integrated 2 bit CMOS parallel control logic
- Integrated ESD protection on digital I/O
- Single 3V positive supply voltage, AC coupled RF
- Impedance matched for 50 Ohm systems

Customized Services That Provide Added Benefits

We know that flexibility is what you need in the fast-paced telecommunications industry. To accommodate your needs, we offer additional customized services tailored to meet your needs, from design to delivery.

My SOI Foundry Services

Honeywell's My SOI Foundry is a complete foundry solution for all your RFIC manufacturing needs. We have been a flexible foundry leader for a variety of markets for over 20 years and are equipped to develop your state-of-the-art ICs using our proven Silicon On Insulator (SOI) technology, responsive service and advanced foundry experience.

Our ISO 9001 certified, on shore, 150mm wafer fab uses the latest six sigma based process controls to ensure your products are developed the way you designed them. We have the manufacturing capacity, cycle time and six sigma quality programs to guarantee your success.

Using your designs and the Honeywell SOI RF/Microwave foundry, we can collaboratively produce the ideal solution for low power cellular, UWB, PCS, GSM basestation and broadband applications, from DC to 10 GHz.

See the Honeywell My SOI Foundry brochure for more on how our capabilities and SOI CMOS technology can generate innovative results for your future designs.

My SOI Test Services

To consistently ensure our high standard of quality wafers, Honeywell conducts thorough standard testing as well as customized test services, from PM testing of wafers to DC and RF characterizations of package components. We utilize onshore as well as offshore test facilities to provide DC and RF production testing.

My SOI Packaging Services

You have a variety of options available with My SOI Packaging to ensure you're able to meet and deliver products that delight your customers. We guarantee high quality, fast delivery and custom packaging for large volume or limited production needs. By partnering with the highest quality high-volume packaging companies, we deliver customized packaging — from wafer thinning, backside gold and solder bumping — that provides the flexibility and quality you can rely on.

Honeywell

The unlimited



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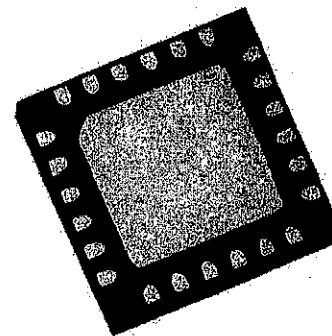
Honeywell

HRF-SW1030

SP6T Absorptive RF Switch DC to 2.5GHz Operation

The Honeywell HRF-SW1030 is a high performance single pole six throw (SP6T) absorptive RF switch that is ideal for use in wireless basestation and handset applications that require minimum power and minimum insertion loss.

The HRF-SW1030 is manufactured with Honeywell's patented Silicon On Insulator (SOI) CMOS technology, which provides the performance of GaAs with the economy and integration capabilities of conventional CMOS technology. These switches are DC coupled to improve lower operating frequency, frequency response and reduce the number of DC bias points required.



HRF-SW1030 in VQFN Package

FEATURES

- Typical High Isolation Of > 42 dB @ 2 GHz
- Typical Low Insertion Loss Of 1.6 dB @ 1 GHz
- Integrated CMOS Control Logic
- DC-coupled, bi-directional RF Path
- Single Positive Supply Voltage
- Ultra Small VQFN Packaging
- Impedance matched for 50 Ohm systems

RF ELECTRICAL SPECIFICATIONS @ + 25°C

Results @ $V_{DD} = 5.0 \pm 10\%$, $V_{SS} = 0$ unless otherwise stated, $Z_0 = 50$ Ohms
Contact Honeywell for relative performance at other supply configurations

Parameter	Test condition	Frequency	Minimum	Typical	Maximum	Units
Insertion Loss		1.0 GHz		1.6	2.5	dB
		2.0 GHz		2.1	3.3	dB
		2.5 GHz		2.4	3.8	dB
Isolation		1.0 GHz	36	50		dB
		2.0 GHz	30	42		dB
		3.0 GHz	27	40		dB
Return Loss			-10	-15		dB
Input P1dB	V _{SS} =Gnd V _{SS} = -5V	1.0 GHz		16		dBm
		1.0 GHz		25		dBm
Input IP3	Two-Tone Inputs, + 5 dBm V _{SS} = Gnd V _{SS} = -5V	2.0 GHz		33		dBm
		2.0 GHz		35		dBm
Trise, Tfall Ton, Toff	10% To 90% 50% Cntl To 90% / 10% RF		10			ns
			20			ns

HRF-SW1030**DC ELECTRICAL SPECIFICATIONS @ + 25°C**

Parameter	Minimum	Typical	Maximum	Units
V _{DD}	3.3 ¹	5.0	5.5	V
V _{SS}	-5.0			V
I _{DD}		<5	35	uA
CMOS Logic Level (0)	0		0.8	V
CMOS Logic Level (1)	V _{DD} - 0.8		V _{DD}	V
Input Leakage Current			10	uA

Note 1 - Performance curves are for VDD = +5.0 +/- 10%

ABSOLUTE MAXIMUM RATINGS¹

Parameter	Absolute Maximum	Units
V _{DD}	+6.0	V
V _{SS}	-5.5	V
Vin Digital Logic 0	-0.6	V
Vin Digital Logic 1	V _{DD} + 0.6	V
Input Power	> 35	dBm
ESD Voltage ²	400	V
Moisture Sensitivity Level	Level 3 @ 240°C	
Solder Reflow Temperature	250	°C
Operating Temperature Range	-40 to +85	°C
Storage Temperature Range	-65 to +125	°C

Note 1 - Operation of this device beyond any of these parameters may cause permanent damage.

Note 2 - Although the HRF-SW1030 contains ESD protection circuitry on all digital inputs, precautions should be taken to ensure that the Absolute Maximum Ratings are not exceeded.

Latch-Up: Unlike conventional CMOS digital attenuators, Honeywell's HRF-SW1030 is immune to latch-up.

TRUTH TABLE

C1	C0	G0	RF Output 1	RF Output 2	RF Output 3	RF Output 4	RF Output 5	RF Output 6
0	0	1	RFINPUT	RFINPUT	RFINPUT	RFINPUT	RFINPUT	RFINPUT
0	1	0						
0	1	1						
1	0	0						
1	0	1						
1	1	0						

"0" = CMOS Low, "1" = CMOS High

Note: For codes 000 and 111 all outputs are in the terminated isolation state.

PIN CONFIGURATIONS

Pin	Function	Pin	Function	Pin	Function	Pin	Function
1	GROUND	7	VDD	13	GROUND	19	GROUND
2	GROUND	8	C2	14	GROUND	20	GROUND
3	RFOUTPUT5	9	C1	15	RFOUTPUT2	21	RFINPUT
4	GROUND	10	C0	16	GROUND	22	GROUND
5	GROUND	11	VSS	17	GROUND	23	GROUND
6	RFOUTPUT4	12	RFOUTPUT3	18	RFOUTPUT1	24	RFOUTPUT6

Note: Bottom ground plate must be grounded for proper RF performance.

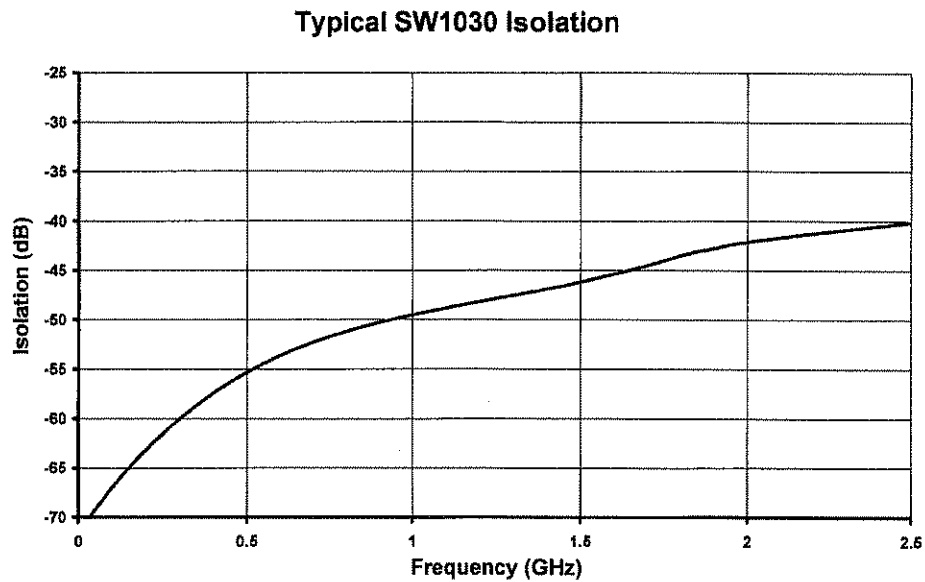
HRF-SW1030

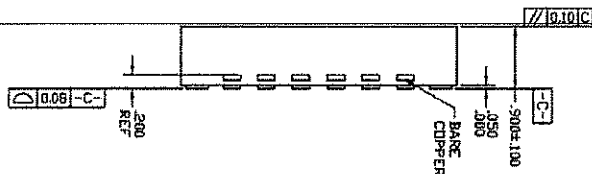
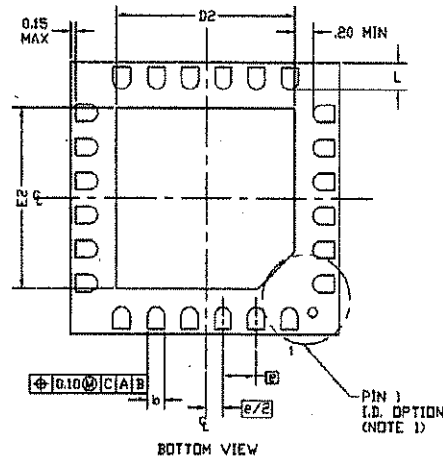
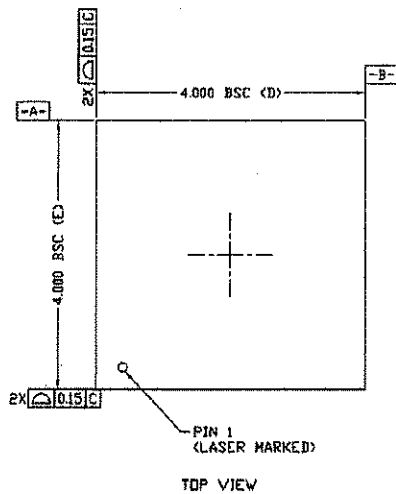
PERFORMANCE CURVES

Insertion Loss



Isolation



HRF-SW1030**PACKAGE OUTLINE DRAWING****Notes**

1. Pin 1 identifier can be a combination of a dot and/or chamfer.
2. Dimensions are in millimeters.

SYMBOL	MIN	NOM	MAX
a	0.50	BSC	
b	0.18	0.25	0.30
E2	2.55	2.65	2.75
D2	2.55	2.65	2.75
L	0.35	0.40	0.45
INTERNAL FEATURE	FUSE LEAD		

LEAD FINISH

The package leads are Nickel Palladium Gold (NiPdAu). The configuration being manufactured and delivered today is lead-free RoHS compliant. Compliant packages have half-etch leadframes and have date codes of 0300 or greater.

LEAD FREE QFN SURFACE MOUNT APPLICATION

Please see Application Note AN310 for assembly process recommendations. Application Notes can be found at our website: www.honeywell.com/microwave

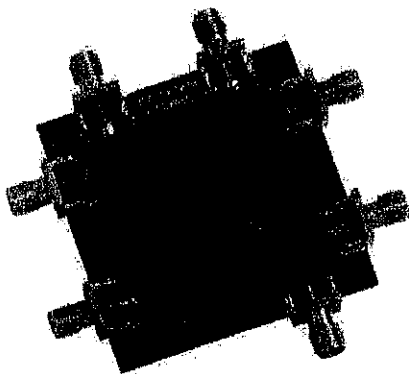
CIRCUIT APPLICATION INFORMATION

These attenuators require a DC reference to ground. They may not operate properly when AC coupled on both the RF input and output without a DC ground reference provided as part of the circuit. See Application Note AN311.

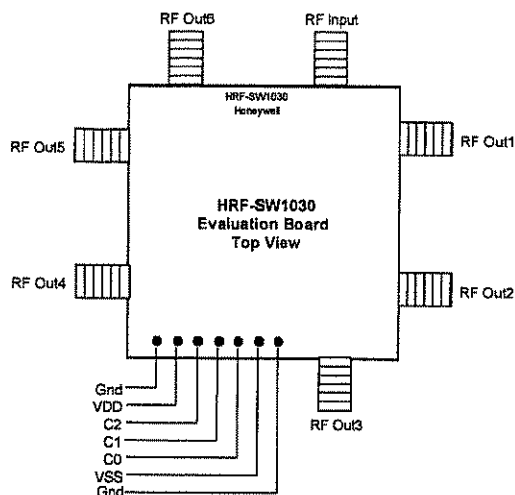
HRF-SW1030

EVALUATION CIRCUIT BOARD

Honeywell's evaluation board provides an easy to use method of evaluating the RF performance of our switch. Simply connect power, DC and RF signals to be measuring switch performance in less than 10 minutes.



HRF-SW1030 Evaluation Board



EVALUATION CIRCUIT BOARD LAYOUT DESIGN DETAILS

Item	Description
PCB	Impedance Matched Multi-Layer FR4
Attenuator	HRF-SW1030 Digital Attenuator
Chip Capacitor	Panasonic Model ECU-E1C103KBQ Capacitor, .01uf 0402 10% 16V
RF Connector	Johnson Connectors Model 142-0701-801 SMA RF Coaxial Connector
DC Pin	Mil-Max Model 800-10-064-10-001 Header Pins

ORDERING INFORMATION

Ordering Number	Delivery Method	Units Per Shipment
HRF-SW1030-AU-TR	Tape & Reel	2500 Units per Reel
HRF-SW1030-AU-T	Tape	< 2500
HRF-SW1030-E	Evaluation Board	One Board Per Box

FIND OUT MORE

For more information on Honeywell's Microwave Products visit us online at www.honeywell.com/microwave or contact us at 800-323-8295 (763-954-2474 internationally).

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